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Lead Scientist's Report

Summary: This report includes five items: (1) Summary of one recent article from the *San Francisco Estuary and Watershed Science* on socio-ecological restoration in the Delta; (2) Summary of one recent article from *Scientific Reports* on the reduction of storm impacts by coastal wetlands; (3) Summary of two brown bag seminars; (4) Summary of "Informing Delta Management Using Biotelemetry" symposium; (5) the By the Numbers Report.

Inhabiting the Delta: A Landscape Approach to Transformative Socio-Ecological Restoration. Milligan, Brett; Kraus-Polk, Alejo. *San Francisco Estuary and Watershed Science*, 15(3). September 2017.

https://escholarship.org/uc/item/9352n7cn

Landscape restoration is generally focused on ecosystem benefits, however, an added bonus of restoration is the creation of spaces that are appealing to humans. This recently published study argues for a more active consideration of human uses of restored lands during the planning of restoration efforts. Not accounting for human uses and values of restored and naturalized lands can lead to diminished public support, performance, and management of restoration projects.

To examine how to better account for human uses when planning restoration projects, the researchers investigated how people currently use restored lands in the Delta. They addressed this issue with multiple perspectives and methods, including reviewing current planning and policy approaches, surveying and interviewing land managers and stakeholders, developing case studies of nine existing restoration projects in the Delta, mapping land use, and field checking targeted sites. Using these mixed methods provided a "landscape approach" to understand how competing land uses can be integrated to create more "equitable, adaptable, and multi-functional landscapes."

The findings show that current human uses of these lands are diverse and extensive, and they include both sanctioned and unsanctioned land uses in the Delta. Existing legislation calls for large-scale restoration of Delta landscapes, and these efforts will lead to large-scale changes in the human uses of these lands. The authors, however, identify that current plans do not adequately account for human uses and cultural values. The authors recommend that more resources and research be aimed at integrative approaches that couple humans and the environment, and that will lead to improved management of future restoration efforts. Mr. Kraus-Polk is a former intern for the Council.

The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA. Narayan, S; Beck, M. B.; Wilson, P.; Thomas, C. J.; Guerrero, A.; Shepard, C. C.; Reguero, B. G.; Franco, G.; Ingram, J. C.; Trespalacios, D. *Scientific Reports,* 7:9463. August 2017.
https://www.nature.com/articles/s41598-017-09269-z

Wetlands can provide coastal communities with natural storm protection and lessen the impact and damages of storms and floods. In this sense, wetlands provide an ecosystem service, which is a benefit to society in the form of a healthy, functioning ecosystem. In this study, researchers quantified the value of temperate coastal wetlands for flood risk and property damage reduction in the northeastern United States, on both a regional and a local scale. Researchers found that in areas with more coastal wetlands there was proportionally greater damage reduction because the wetlands decreased the height of flood waters associated with storms.

Using flood and loss models (which are used by insurance companies to estimate property losses at flooded locations), researchers found that regions with wetlands avoided more than $625 million in storm damages across the 12 coastal states affected by Hurricane Sandy. In New York, where wetlands cover only 2 percent of the coastline, wetlands reduced storm damages by $140 million; while this was only 0.4 percent of the state's total losses, it still demonstrates substantial benefits from a small amount of wetland acreage.

For their local investigation, researchers looked at a county in New Jersey that was impacted by Hurricane Sandy and covers an area similar to the size of the Sacramento-San Joaquin Delta. A large proportion of natural wetlands have been filled for development in this county; researchers calculated the annual cost from flooded properties using a series of simulated storm events in areas where coastal wetlands were both present and absent. While the magnitude of flood benefits varied across elevations (with less loss occurring at higher elevations), in all cases the presence of wetlands greatly reduced the amount of property damage experienced. On average, properties located behind wetlands saved 16 percent in flood losses per year.

In addition to local wetlands providing direct avoidance of storm damages in coastal regions, downstream wetlands also reduced flooding pressure to areas located at the upstream end of the estuary. This last finding illustrates how the health of downstream wetlands (such as those in the San Francisco Estuary) can benefit upstream areas, providing incentives for regional-scale wetland conservation and management.

Brown Bag Seminars

***Monitoring the Effectiveness of Tidal Wetland Restoration for the Benefit of Native Fishes* – Stacy Sherman, Ph.D., Environmental Program Manager Fish Restoration Program Monitoring, California Department of Fish and Wildlife.**

Over the coming year, the Delta Independent Science Board (Delta ISB) will be undertaking a broad review of the monitoring enterprise in the Delta; to help inform this review, the Delta ISB is hosting a three-part seminar series covering the current state of monitoring in the Delta. The first of these brown bags was presented by Dr. Stacy Sherman and focused on the monitoring efforts for the Fish Restoration Program (FRP). The Fish Restoration Program Agreement (FRPA), between the California Department of Fish and Wildlife (DFW) and the Department of Water Resources (DWR), addresses specific habitat restoration requirements of the US Fish and Wildlife Service and the National Marine Fisheries Service biological opinions for State Water Project (SWP) and Central Valley Project operations. The FRPA is also intended to address the habitat requirements of the DFW Longfin Smelt Incidental Take Permit (ITP) for SWP Delta operations. The FRPA was signed by the directors of DWR and DFW on Oct. 18, 2010 and has been amended once (Nov. 15, 2010) since that time.

The FRP has four main goals: 1) restore 8,000 acres of intertidal habitat in the Sacramento-San Joaquin Delta and Suisun Marsh to enhance food production and availability for native Delta fishes; 2) restore processes that will promote primary and secondary production and tidal transport of resources to enhance the pelagic food web in the Delta; 3) increase the amount and quality of salmonid rearing habitat; and 4) increase through-Delta survival of juvenile salmonids.

Dr. Sherman's team is responsible for the wetland monitoring efforts of the FRP, which currently includes seven restoration sites, and seven reference or comparison sites to evaluate restoration effectiveness. The FRP monitoring also addresses the potential impacts of stressors, such as non-native species and contaminants. To develop the monitoring program, the FRP monitoring group worked with the Interagency Ecological Program Project Work Team to develop a series of conceptual models that explore how restored wetlands may affect fish species of concern. These models were used to inform the monitoring design for the FRP, from hypotheses and metrics of success to monitoring methods. These products have been incorporated into a guidance document to promote consistency in monitoring methods across all groups interested in habitat restoration in the Delta.

In addition to outlining the FRP monitoring approach, Dr. Sherman outlined what she believed to be gaps in wetland-related monitoring, including the need for a

dedicated funding source for non-fish monitoring restoration projects, more attention to species that are not included in their current efforts (such as mammals, birds, and microbes), improved communication between scientists and managers, and flexible work plans to address issues of take for targeted species.

***Planning and Modeling Tools (including ELAM) for Salmon Survival and Water Project Operations "Delta Actions-Outcomes" Status and Development* – Ryan Reeves, PE (California Department of Water Resources, Bay-Delta Office) and Dave Smith, Ph.D. (U.S. Army Corps of Engineers, Engineer Research and Development Center)**

The ELAM (Evaluating Likely Animal Movement or Eulerian-Lagrangian-Agent Method) model is a physics-based modeling system that allows researchers to convert an organism's natural behaviors or patterns of movement into mathematical formulas. Essentially, ELAM is an approach to analyze and predict the movement and distribution of individuals based on their predicted responses to environmental conditions. Ryan Reeves provided an overview of the ELAM model, highlighting its use to evaluate fish behavior in response to different hydrodynamic scenarios. In addition, Mr. Reeves identified how ELAM can be combined with other models (e.g., hydrodynamics and survival models) to prioritize proposed management actions and he discussed planning issues for model use, including the importance of considering the scale at which a project is intended to produce an outcome.

In the second part of the seminar, Dr. Dave Smith discussed applications of ELAM in restoration design situations. These design applications are especially challenging because the proposed systems do not yet exist, so specific calibration data are not available. Dr. Smith discussed a case study, focusing on the size and location of the proposed notch in the Fremont Weir. The ELAM model is one of the many models that has the potential to inform resource managers on design options; it can use local satellite data of the surrounding landscape and the bathymetry (depth measurements) of the channel to create a new spatial domain that captures what the notch might look like, "run" water through the notch to create a flow field, and ultimately predict the entrainment rates of fish for different design alternatives of the proposed notch. The results from the model provide valuable information to evaluate design details that would not otherwise be possible.

This brown bag was part of the integrated modeling brown bag series which also included a brown bag on Aug. 15, 2017 by Dr. Jim Peterson from the U.S. Geological Survey. The goal of the series was to increase awareness and understanding of current integrated modeling efforts. The Delta Plan Interagency Implementation Committee endorsed guiding principles for an effective science enterprise at its April 2017 meeting; integrated modeling and forecasting is an

integral component. Since April 2017, the Council has convened an integrated modeling steering committee with commitments from agencies, staff, consultants, and academics.

Summary of "Informing Delta Management Using Biotelemetry" symposium

Managing the Delta for the benefit of fish species, including salmon and sturgeon, requires an understanding of fish movement, behavior and survival through the Delta. Over the last decade, advancements in telemetry—a process by which data is collected remotely and transmitted to receiving equipment—have enabled scientists to track fish more effectively and answer questions about their behavior and survival that were previously unknown. On November 9, the Delta Science Program, University of California, Davis, and Cramer Fish Sciences partnered to host a one-day symposium focusing on the use of telemetry data to inform management questions. Specific management implications of telemetry data were discussed, including:

- Management issues during periods of drought;
- Relationship between water flow and fish survival;
- Effectiveness of hatchery management strategies;
- Effects of predators on prey species of interest;
- Fish behavior and management strategies in Clifton Court Forebay;
- Salmon survival and management of the Yolo Bypass; and
- Strategies for improving telemetry technology and management applications moving forward.

The symposium presented an opportunity for experts in the field to present and discuss current findings and management implications of their research with managers and other scientists. The event was recorded and will be available online, and a summary article synthesizing the key findings from the event is being prepared. In addition, a follow-up symposium is being planned to expand on current topics and address the challenges to building an integrated, sustainable telemetry program, with a goal of coordinating funding and leadership so that telemetry data can be effectively used in planning and management decisions.

By the Numbers

Delta Science Program staff will give a summary of current numbers related to Delta water and environmental management. The summary (Attachment 1) will inform the Council of recent counts, measurements, and monitoring figures

driving water and environmental management issues.

List of Attachments

Attachment 1: By the Numbers Summary (*report to be provided at the Council Meeting*)

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